SMD Operations Procedures Manual

8.1.1.7 TEST OF SAFETY INTERLOCKS OF THE SHORT SAMPLE TEST FACILITY, TWIN 15 kA POWER SUPPLIES

Text Pages 1 through 10
Attachments 1, 2

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8.1.1.7 Test of Safety Interlocks of Short Sample Test Facility, Twin 15 kA Power Supplies

1.0 Purpose and Scope

1.1 The purpose of this Procedure is to provide step by step instruction in testing the Kirk Locks, electrical door interlocks, "crash" push buttons, DC overcurrent protection circuits, and warning lights associated with the twin 15kA power supplies.

2.0 Responsibilities

2.1 The Cognizant Engineer (CE) for the power supplies, or the Electrical Systems Section Head, shall:

2.1.1 Designate those persons authorized to perform the procedure.

2.1.2 Establish and maintain a list of authorized persons.

2.1.3 Appoint a Cognizant Technician for the Interlock Test database.

2.1.4 Review the completed "Interlock Test CheckList" (Attachment 1) and sign the "Interlock Test Approval Form" (Attachment 2).

2.2 The Cognizant Technician shall:

2.2.1 Initiate the procedure, when required.

2.2.2 Establish and maintain a paper database for the interlock test.

2.2.3 Arrange for the "Interlock Test Approval Form" to be posted at the appropriate locations.

2.3 Persons performing the procedure shall:

2.3.1 Complete the "Interlock Test Check List."

3.0 Prerequisites

3.1 Authorized persons shall have the following qualifications and training:

3.1.1 Be instructed by the Cognizant Engineer for the power supplies;

3.1.2 Have a generic "working hot" permit for Range B hazards, as defined by ESH Standard 1.5.0, section IV.;

3.1.3 Be trained as a "Responsible Employee", as defined by ESH Standard 1.5.1, "Lockout/Tagout Requirements".

4.0 Precautions

4.1 The procedure requires that the Kirk Lock system be bypassed, or "defeated", during some tests. The Kirk Lock system shall be restored to full working order after the procedure is completed.

4.2 All doors that were unlocked for the purpose of testing the interlocks shall be locked when the procedure is completed.

5.0 Procedure

5.1 The procedure shall be performed half-yearly.

5.2 As each step is completed, check the appropriate boxes on the Interlock Test Check List (Attachment 1).

5.3 If a failure occurs, stop work, write "fail", and immediately notify the Cognizant Engineer.

5.4 Door Interlocks

PS1 and PS2 of the Short Sample Power Supply System have electrical Door Interlocks on each of the four doors of the Main P.S. Enclosure and one on each Control Cabinet door. There is also one on the Short Sample Link Box.

In addition, there are captive Kirk key locks on the Short Sample Link Box, the Control Cabinet doors and one of the Main Enclosure doors at the 460Vac input which make it impossible to enter those doors with power ON without defeating the captive lock.

5.4.1 The electrical Door Interlocks on those doors with Kirk key locks can be checked as follows:

5.4.1.1 With input power OFF, defeat the captive key lock permitting access with power ON.

5.4.1.2 Leave the door open enough to activate the Interlock switch.

5.4.1.3 Energize the control circuits and RESET the faults.

5.4.1.4 Verify that there is a DOOR interlock fault.

5.4.1.5 De-energize the control circuits and lock the door.

5.4.1.6 Energize the control circuits and verify that a READY state can be obtained.

5.4.1.7 Repeat the process for each of the doors equipped with Kirk key locks.

5.4.2 The electrical Door Interlocks on doors without Kirk key locks can be checked as follows:

5.4.2.1 With input power OFF, unlock and open the door enough to activate the Interlock switch.

5.4.2.2 Energize the control circuits and RESET the faults.

5.4.2.3 Verify that there is a DOOR interlock fault.

5.4.2.4 Close and lock the door and verify that the fault indication remains until the fault is RESET and that the P.S. is then READY.

5.4.2.5 Repeat the process for each of the doors without Kirk key locks.

5.5 DC Overcurrent

5.5.1 The DC Overcurrent of each P.S. is checked as follows:

5.5.1.1 Connect a shorting bar across the P.S. output.

5.5.1.2 Enter the control cabinet of the power supply and defeat the Kirk key lock.

NOTE: ***Measure the DC voltage first from TP6 and TP1 before any adjustment are made. Record these reading so that the overcurrent trip voltage can be set to its correct setting after overcurrent testing are completed.***

5.5.1.3 Energize the control circuits and reduce the DC Overcurrent trip voltage from TP6 and TP1 of the P.S. AUX CARD from its initial value to 1.0Vdc by adjusting R33 (see Drawing No. 33E-26.01-3).

5.5.1.4 Before turning on the DC, make sure the manual/DAC switch is set to manual mode and the current potentiometer is set to ZERO.

5.5.1.5 Increase the output current and monitor the Shunt Buffer output at TP3.

5.5.1.6 With TP1 and TP6 voltage set to 1 volt, the DC power supply should cause an Overcurrent at 1500 Amps.

5.5.1.7 Verify that the READY state can be obtained with a RESET.

5.5.1.8 Return the DC Overcurrent trip setting to its initial value.

5.5.1.9 Turn the DC ON and increase the output current while monitoring the Shunt Buffer voltage at TP6 and TP1. Increase the current to its maximum value (15kA, PS1; 15kA, PS2).

5.5.1.10 Verify that the TP3 voltage does not exceed the TP6 voltage and that the power supply does not trip out on Overcurrent.

5.5.1.11 De-energize the power supply, restore the Kirk key lock on the control cabinet.

5.6 <u>P.S. CRASH Push Buttons</u>

5.6.1 The following test of the P.S. CRASH push buttons can be conducted only while the system is being operated remotely by the computer.

NOTE: ***While the system is being operated remotely and before any CRASH buttons tests are performed, the MANUAL/DAC switch and current potentiometer are in there proper positions.***

5.6.1.1 Energize PS1 and PS2, clear faults with a RESET and go to the DC ON state for both Supplies. Increase the output current to 100A.

5.6.1.2 Depress the CRASH push button at the SAMPLE PS Interface Panel and verify that both power supplies go to a Fault state and that PS1 CRASH and PS2 CRASH are indicated on the monitor.

5.6.1.3 Repeat steps 5.6.1.1 and 5.6.1.2 above for the CRASH push buttons on the MAGNET PS Interface Panel, the two CRASH push buttons in the P. S. room, O22A, and the CRASH push button in the Cryogenic Controls area.

5.6.1.4 Remove shorting bars from link box.

5.7 Kirk Key Lock Mechanical System Test

OVERVIEW

Note: ***The safety Kirk lock system of the Short Sample Test Facility was designed to accommodate multitasking within the various stages of setup and testing of Superconducting magnet cable. Below is explanation of each integrated part.***

Within each test dewar their are three set of safety enclosures that protect the power leads used to energize superconducting test cable and a magnet coil. Each positive and negative power lead and magnet coil has an independent cover with the following designation. S4+, S4-, M4, S5+, S5-, M5, S6+, S6-, M6.

Each dewar test cage entry door has a Kirk lock installed on them designated as G4, G5, and G6. Dewar cage entry doors G4 and G5 have two doors that share the same Kirk key.

In the Short Sample control room there is three banks of four Kirk key locks. These are designated as the Magnet Cover Safety Kirk key Interlock Logic Panel. Next to that panel is four banks of five Kirk Key locks. This is called the Power Supply Safety Kirk Key Interlock Logic Panel.

On each power supply main disconnect switch is a Kirk Key lock labeled PS, PSS, PM and PSM. Kirk Keys PS and PM are the final results after all the correct Kirk Key logic has been satisfied in the Short Sample control room. Then each main power switch can be activated to each Short Sample power supply to conduct cable testing. The PSS and PSM Kirk keys are used to gain entry to the power supply doors for periodic maintenance. These Kirk keys in conjunction with the PS and PM Kirk key can gain entry to the Short Sample Link Box.

SEQUENCE OF OPERATION OF THE KIRK KEY SAFETY INTERLOCK SYSTEM

To perform a superconducting cable test, the Short Sample control room operator must insure that all safety covers on both test dewars that are not in use be secured and have Kirk key inserted in the proper designated Kirk locks (Magnet Cover Safety Kirk Key Interlock Logic Panel). Once this condition is satisfied, the Magnet Supply key (MS#) can be removed and inserted into the "Power Supply Safety Kirk Key Interlock Logic Panel" along with the gate key from the dewar facility be used for the cable test.

When all these conditions have been satisfied in the "Power Supply Safety Kirk Key Interlock Logic Panel," both the Power Supply Short Sample Key (PS#) and Power Supply Magnet (PM#) can be removed. These Kirk Keys can now be inserted into their respective Kirk locks to activate the main power supply to conduct superconducting cable testing.

NOTE: OPM 8.1.1.39, Test of Safety Interlocks for the Short Sample Test Facility, Magnet Power Supply should be done concurrently with this interlock test.

5.7.1 The Kirk Locks are tested as follows:

5.7.1.1 Unlock all dewar power and magnet leads safety covers (S+,S-,M) and verify that the Kirk Keys can not be removed.

5.7.1.2 Unlock dewar gates and verify that the Kirk key can not be removed.

5.7.1.3 In the "Magnet Cover Safety Kirk Key Interlock Logic Panel" in the Short Sample Control Room, verify that these (MS#) keys can not be removed from the locks without the logic condition be satisfied.

5.7.1.3 In the "Power Supply Safety Kirk Key Interlock Logic Panel" in the Short Sample Control Room, verify that these PS# and PM# keys can not be removed from the locks without the logic condition be satisfied.

5.7.1.4 Lock all dewar gates and remove Kirk lock keys G4, G5, and G6.

5.7.1.5 In the twin 15 kA Link Box, place the twin 15 kA supplies into a shorted condition.

5.7.1.6 Insert the dewar gate Kirk keys into the bypass Kirk Locks in the "Power Supply Safety Kirk Key Interlock Logic Panel." When this condition is satisfied, remove the PS and PM Kirk Keys.

5.7.1.7 Use the PS Kirk key to open the Main Lock at the Disconnect Switch and energize the Main Disconnect Switches.

5.7.1.8 Attempt to turn the key to remove it. Attempt to remove the key by re-closing the door. Verify that this cannot be done.

5.7.1.9 Attempt procedure 5.7.1.8 with the PSS Kirk Key.

5.7.1.10 De-energize the Main Disconnect Switches, re-close the door and remove the key.

5.7.1.11 Use the Kirk keys PS and PSS to open the doors of the Transformer Link Box and attempt to remove the key while the door is still open. Verify that this cannot be done. Re-close the door, remove the keys and verify that the door cannot be opened.

5.8 "PS ON" Light Box Test

5.8.1 The "PS ON" Light Box on the Short Sample Link Box is tested as follows:

5.8.1.1 Energize the Short Sample Power Supply (PS1), bringing it to a READY state by means of the Computer controls. Verify that the "PS ON" light is still OFF.

5.8.1.2 Put PS1 in the ON state at minimum current. Verify that the "PS ON" light is ON.

5.8.1.3 De-energize PS1 and verify that the "PS ON" light goes out.

5.8.1.4 Repeat steps 5.8.1.1 through 5.8.1.3 for PS2, the Magnet Power Supply.

5.9 Complete, date, and sign the Interlock Test Check List.

5.10 The CE/ESSH shall review the Check List and sign an "Interlock Test Approval" form (Attachment 2), which shall be posted on the Short Sample Power Supplies, the Short Sample Link Box, and in the Short Sample Control Room.

5.11 The Cognizant Technician shall maintain a file containing:
A. One copy of the Check List;
B. One copy of the Approval Form.

6.0 Documentation

6.1 Interlock Test Check List.

6.2 Interlock Test Approval Form

7.0 References

7.1 ESH Standard 1.5.1, "Lockout/Tagout Requirements".

7.2 ESH Standard 1.5.0, “Electrical Safety”.

7.3 Drawing No. 33E-26.01-3

8.0 Attachments

1. Interlock Test Check List, "TEST OF SAFETY INTERLOCKS"

2. Interlock Test Approval Form

Attachment 1

TEST OF SAFETY INTERLOCKS
TWIN 15 kA POWER SUPPLIES

ID#	DISCRIPTION	LOCATION	CHK
KL-1	Dewar Short Sample Power lead covers interlock (S+,S-)	DEWAR 4	
KL-2	Dewar Short Sample Power lead covers interlock (S+,S-)	DEWAR 5	
KL-3	Dewar Short Sample Power lead covers interlock (S+,S-)	DEWAR 6	
KL-4	Kirk lock in SSCR interlock cover master key (M4)	SSCR	
KL-5	Kirk lock in SSCR interlock cover master key (M5)	SSCR	
KL-6	Kirk lock in SSCR interlock cover master key (M6)	SSCR	
KL-7	Kirk lock gate key (G4)	DEWAR 4	
KL-8	Kirk lock gate key (G5)	DEWAR 5	
KL-9	Kirk lock gate key (G6)	DEWAR 6	
KL-10	Kirk lock in SSCR interlock power supply master key (PS)	SSCR	
KL-11	Kirk lock in SSCR interlock power supply master key (PS)	SSCR	
KL-12	Kirk lock in SSCR interlock power supply master key (PS)	SSCR	
KL-13	Kirk lock on main disconnect switch (PS Key)	P.S. Room	
KL-14	Kirk lock on main disconnect switch (PSS Key)	P.S. Room	
KL-15	Kirk lock on PS1 XFMR1 link box	P.S. Room	
KL-16	Kirk lock on PS1 control cabinet door	P.S. Room	
KL-17	Kirk lock on PS2 XFMR2 link box	P.S. Room	
KL-18	Kirk lock on PS2 control cabinet door	P.S. Room	
KL-19	Kirk lock on PS2 door	P.S. Room	
KL-20	Kirk lock on Short Sample P.S. link box	DEWAR AREA	
DIL-1	Interlock on PS1 control cabinet door	P.S. Room	
DIL-2	Interlock on PS1 door	P.S. Room	
DIL-3	Interlock on PS1 door	P.S. Room	
DIL-4	Interlock on PS1 door	P.S. Room	
DIL-5	Interlock on PS1 door	P.S. Room	
DIL-6	Interlock on PS2 control cabinet door	P.S. Room	
DIL-7	Interlock on PS2 door	P.S. Room	
DIL-8	Interlock on PS2 door	P.S. Room	
DIL-9	Interlock on PS2 door	P.S. Room	
DIL-10	Interlock on PS2 door	P.S. Room	
DIL-11	Interlock on Short Sample P.S. link box	DEWAR AREA	
DCO-1	DC overcurrent interlock – PS1	P.S. Room	
DCO-2	DC overcurrent interlock – PS2	P.S. Room	
CB-1	Crash button	P.S. Room	
CB-2	Crash button	P.S. Room	
CB-3	Crash button	SSCR	
CB-4	Crash button	SSCR	
CB-5	Crash button	CRYO AREA	
WL-1	Flashing warning light	DEWAR AREA	

Date of Test_____ Tested by_____ Life #_____
_____ Life #_____

Attachment 2

Safety Interlock Test Approval

The safety interlocks of the Short Sample Power Supply System have been tested and approved

Approval Date_____

The approval is valid until the expiration date shown. DO NOT OPERATE THE SHORT SAMPLE POWER SUPPLIES AFTER THE EXPIRATION DATE.

Expiration Date_____

Approval Signature (CE or ESSH) _____

Post on PS1 Control Cabinet

Safety Interlock Test Approval

The safety interlocks of the Short Sample Power Supply System have been tested and approved

Approval Date_____

The approval is valid until the expiration date shown. DO NOT OPERATE THE SHORT SAMPLE POWER SUPPLIES AFTER THE EXPIRATION DATE.

Expiration Date_____

Approval Signature (CE or ESSH) _____

Post on PS2 Control Cabinet

Safety Interlock Test Approval

The safety interlocks of the Short Sample Power Supply System have been tested and approved

Approval Date_____

The approval is valid until the expiration date shown. DO NOT OPERATE THE SHORT SAMPLE POWER SUPPLIES AFTER THE EXPIRATION DATE.

Expiration Date_____

Approval Signature (CE or ESSH) _____

Post on Short Sample Link Box

Safety Interlock Test Approval

The safety interlocks of the Short Sample Power Supply System have been tested and approved

Approval Date_____

The approval is valid until the expiration date shown. DO NOT OPERATE THE SHORT SAMPLE POWER SUPPLIES AFTER THE EXPIRATION DATE.

Expiration Date_____

Approval Signature (CE or ESSH) _____

Post on SSCR Control Panel

Safety Interlock Test Approval

The safety interlocks of the Short Sample Power Supply System have been tested and approved

Approval Date_____

The approval is valid until the expiration date shown. DO NOT OPERATE THE SHORT SAMPLE POWER SUPPLIES AFTER THE EXPIRATION DATE.

Expiration Date_____

Approval Signature (CE or ESSH) _____

File Copy